

In Response to the Office Action dated February 10, 2009

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listing, of claims in the application.

Listing of Claims:

1. (Currently Amended) A method of monitoring a system instrumented with sensors by selecting input vectors for extraction of representative data for training of an adaptive model, the input vectors data being organized along an independent ('x') dimension to enable selection of vectors along a dependent ('y') dimension, the method comprising:

receiving signals automatically as input to a computer and ~~from a plurality of sensors~~ as a set of training vectors, said signals being derived from a plurality of the sensors and representing physical parameters of the monitored system;

automatically ordering the set of training vectors according to a corresponding value in each vector of a particular sensor and assigning each training vector a sequence number according to the ordering to form the 'x' dimension of the data with the sequence numbers;

automatically dividing the set of training vectors according to equally spaced ranges selected across the magnitude of the data, the magnitude forming the 'y' dimension of the data;

automatically selecting at least one vector from each of the equally spaced ranges while selecting less than all of the training vectors of the equally spaced ranges for training the adaptive model; and

automatically training the adaptive model with only the vectors selected in the selecting step and with training calculations that use sensor reading values from the signals that form the vectors.

2. (Original) A method according to claim 1, further comprising the step of including for training the adaptive model each vector that contains a maximum or a minimum value for any given sensor across the set of training vectors.

3. (Original) A method according to claim 1, further comprising carrying out the ordering, dividing and selecting steps for each sensor represented in the set of training vectors.

4. (Original) A method according to claim 1, wherein said ordering step comprises ordering the set of training vectors according to the magnitude of the particular sensor.

5. (Original) A method according to claim 4, wherein a vector is selected from one of the equally spaced ranges through the ordering by magnitude such that the selected vector is the vector with a sensor value highest within the range.

6. (Original) A method according to claim 1, wherein said ordering step comprises ordering the set of training vectors so as to provide a cumulative density function for the particular sensor.

7. (Original) A method according to claim 6, wherein a vector is selected from one of the equally spaced ranges through the cumulative density function such that the selected vector is the vector with a sensor value highest within the range.

8. (Currently Amended) An apparatus for training an adaptive model ~~apparatus~~ for monitoring a system instrumented with sensors, comprising:

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data acquisition means for automatically acquiring signals from sensors representative of operational states of the monitored system;

an empirical modeling module responsive to the data acquisition means for automatically providing indications about the operational states of the monitored system;

a data store for automatically storing modeling parameters for use by the empirical modeling module; and

a training module to automatically distill characteristic operational sensor data acquired from the monitored system to a representative set of sensor data for storing in the data store and to train an empirical model of said empirical modeling module, by selecting, from the characteristic operational sensor data, time-correlated observations representative of regularly spaced intervals, wherein the number of observations selected is less than the total number of observations within the intervals, and selected across the magnitude of the data and forming a 'y' dimension of the data, and selected along an ordering of the observations according to values in the observations of a particular sensor, wherein each observation is assigned a sequence number according to the ordering, the sequence numbers forming the 'x' dimension of the data.

9. (Original) An apparatus according to claim 8, wherein the training module includes in the representative set of sensor data observations having a maximum or a minimum value for a particular sensor across all the characteristic operational sensor data.

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10. (Previously Presented) An apparatus according to claim 8, wherein selection of observations representative of regularly spaced intervals is performed for an ordering for each sensor in the system.

11. (Original) An apparatus according to claim 8, wherein said ordering is according to the magnitude of the particular sensor.

12. (Original) An apparatus according to claim 8, wherein said ordering is according to the cumulative density function for the particular sensor.

13. (Currently Amended) A method of monitoring a system instrumented with sensors by selecting a set of training vectors representative of a system, said training set forming an empirical model of said system, said method comprising the steps of:

a) automatically collecting historical data by using a computer and a memory, said historical data including a plurality of system vectors each indicating an operating state of said system, each of said vectors containing elements derived from values of a plurality of sensors representing physical system parameters of said system;

b) automatically selecting one of said [[a]] system parameters of said system;

c) automatically ordering said plurality of system vectors according to a value of each said vector related to said selected system parameter, assigning a sequence number to each said ordered vector according to the ordering, and using the sequence numbers to represent an 'x' dimension of data;

d) automatically binning said plurality of vectors according to said ordering of said selected parameter by forming bins selected across the magnitude of the data, wherein the magnitude forms a 'y' dimension of the data;

e) automatically selecting a vector from each bin;

f) only selected said vectors forming a training set while including less than all ordered vectors in the training set, and said training set forming said empirical model for monitoring system operation including training with calculations that use sensor reading values from said historical data and used to form said selected vectors.

14. (Original) A method as in claim 13 wherein the step b) of selecting a system parameter comprises identifying dominant driver parameters.

15. (Previously Presented) A method according to claim 14 wherein the step b) of selecting system parameters further comprises selecting a bin number, said bin number being used in binning step d) said bin number determining the number of bins in which the plurality of vectors is divided.

16. (Previously Presented) A method as in claim 15 wherein the bin number provided for dominant driver parameters is greater than the bin number used for all other parameters.

17. (Original) A method as in claim 15 wherein said system vectors are ordered in step b) in ascending magnitude order for said selected parameter.

18. (Original) A method as in claim 15 wherein said system vectors are ordered in step b) in descending magnitude order for said system selected parameter.

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19. (Original) A method as in claim 15 wherein in the step e) of selecting a vector from each bin, one of the plurality of system vectors is identified as having a value for said selected parameter closest to a bin magnitude of each bin, identified ones being selected for initial inclusion in said training set.

20. (Original) A method as in claim 15 wherein in the step e) of selecting a vector from each bin, one of the plurality of system vectors is identified as having a value for said selected parameter closest to but not exceeding a bin magnitude of each bin, identified ones being selected for initial inclusion in said training set.

21. (Original) A method as in claim 15 wherein in the step e) of selecting a vector from each bin, one of the plurality of system vectors is identified as having a value for said selected parameter closest to but not less than a bin magnitude of each bin, identified ones being selected for initial inclusion in said training set.

22. (Cancelled)

23. (Cancelled)

24. (Cancelled)

25. (Previously Presented) A method as in claim 15, after the step e) of selecting vectors from each bin further comprising the steps of:

g) checking system parameters to determine if other parameters remain unselected; if other parameters are determined to remain unselected,

h) selecting an unselected parameter, said unselected parameter being identified as the selected parameter;

i) returning to step c) and repeating steps c) through h) until all system parameters have been selected; otherwise,

j) eliminating redundant selected vectors; and

k) storing said selected vectors as a training set for modeling and monitoring system operation.

26. (Currently Amended) A system for automatically monitoring activity of another system, said system comprising:

a control unit controlling a monitored system;

a data acquisition unit receiving information from said control unit and from said monitored system and providing system snapshots therefrom, system snapshots representing the state of said monitored system relative to the time the snapshot is taken, each snapshot having values for a plurality of parameters associated with the monitored system and being a vector;

a memory storing said system snapshots;

a sorter sorting collected system snapshots responsive to a selected system parameter and sorting the system snapshots into an order based on the value of each snapshot corresponding to the selected parameter, assigning each system snapshot a sequence number according to the order, and using the sequence numbers to form an 'x' dimension of data;

a plurality of bins selected across the magnitude of data and forming a 'y' dimension of the data; and

a vector selector binning sorted snapshots as the vectors and selecting a vector from each bin and, only said selected vector being a system snapshot provided to

include in a training set so that said training set includes less than all of said vectors included within the bins.

27. (Original) A system as in claim 26 further comprising:
means for eliminating redundant collected vectors, remaining said vectors forming said training set; and
a memory storing said training set.

28. (Previously Presented) A system as in claim 27, wherein the vector selector divides the range of said selected system parameter into a plurality of evenly spaced bins and selects a sorted snapshot from each bin as the selected vector, each said selected vector being identified as having a parameter value closest to a corresponding bin value.

29. (Cancelled)

30. (Cancelled)

31. (Previously Presented) A system as in claim 26 wherein the vector selector divides the range of said selected system parameter into bins having equal number of system snapshots.

32. (Currently Amended) A computer program product for selecting input vectors for extraction of representative data for training of an adaptive model, said computer program product comprising a computer readable medium having

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~~computer readable program code~~ executable instructions thereon which when executed cause a processor to execute:

a ~~process~~ step for receiving signals as input from a plurality of sensors as a set of training vectors;

a ~~process~~ step for automatically ordering the set of training vectors according to a corresponding value in each vector of a particular sensor, assigning a sequence number to each ordered vector according to the ordering, and using the sequence numbers to form an 'x' dimension of data;

a ~~process~~ step for automatically dividing the set of training vectors according to equally spaced ranges selected across the magnitude of the data and forming a 'y' dimension of the data; and

a ~~process~~ step for automatically selecting at least one vector, but less than all vectors, from each of the equally spaced ranges, to train the adaptive model.

33. (Previously Presented) A computer program product for selecting input vectors according to claim 32, further comprising computer readable program code on said computer readable medium which cause a processor to execute a process for selecting for inclusion in training the adaptive model each vector that contains a maximum or a minimum value for any given sensor across the set of training vectors.

34. (Previously Presented) A computer program product for selecting input vectors according to claim 32, wherein the process for ordering orders the set of training vectors according to the magnitude of the particular sensor.

35. (Original) A computer program product for selecting input vectors according to claim 34, wherein a vector is selected from one of the equally spaced

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ranges through the ordering by magnitude such that the selected vector is the vector with a sensor value highest within the range.

36. (Previously Presented) A computer program product for selecting input vectors according to claim 32, wherein the process for ordering orders the set of training vectors so as to provide a cumulative density function for the particular sensor.

37. (Previously Presented) A computer program product for selecting input vectors according to claim 36, wherein a vector is selected from one of the equally spaced ranges through the cumulative density function such that the selected vector is the vector with a sensor value highest within the range.

Claims 38-49 (Cancelled)

50. (Previously Presented) A computer program product for selecting input vectors according to claim 33, further comprising computer readable program code means for iteratively executing across all sensors in said training vectors, said ordering, dividing and selecting computer program code means.

51. (Previously Presented) A computer program product for selecting input vectors according to claim 50, further comprising computer readable program code means for eliminating redundant selected vectors.

52. (Previously Presented) The apparatus according to claim 8 wherein the training module uses sensor reading values obtained from the observations in calculations.

53. (Previously Presented) The system as in claim 26 further comprising a training module that uses sensor reading values from the selected vectors in calculations.

54. (Previously Presented) The computer program product according to claim 32 further comprising a training process that uses sensor reading values from the selected vectors in calculations to train the adaptive model.